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# On-Orbit Autonomous Assembly from Nanosatellites

## A Small Satellite Autonomous Rendezvous and Docking Demonstration

The On-Orbit Autonomous Assembly from Nanosatellites (OAAN) project will demonstrate autonomous control algorithms for rendezvous and docking maneuvers; low-power reconfigurable magnetic docking technology; and compact, lightweight and inexpensive precision relative navigation using carrier-phase differential (CD) GPS with a three-degree of freedom ground demonstration. CDGPS is a specific relative position determination method that measures the phase of the GPS carrier wave to yield relative position data accurate to .4 inch (1 centimeter). CDGPS is a technology commonly found in the surveying industry. The development and demonstration of these technologies will fill a current gap in the availability of proven autonomous rendezvous and docking systems for small satellites.

The OAAN project will use optimized reconfigurable magnetic arrays to create a robust, low-power docking mechanism compact enough to use only 10 percent of a three-unit (3U) CubeSat with the approximate dimensions of about 4 inches x 4 inches x 13 inches (10 centimeters x 10 centimeters x 34 centimeters) and weighing approximately 9 pounds (4 kilograms). The OAAN project will integrate commercially-available hardware for attitude determination and control, relative navigation, and propulsion and processing. CDGPS will replace expensive optical navigation systems to produce centimeter-relative position knowledge.

Autonomous docking of small satellites is the first step in enabling new and


*Early Artist's Concept*

old mission concepts. The number of CubeSats in an array could be scaled and then assembled in space to create modular satellites, scientific instruments, and space telescopes. If successful, the OAAN systems for relative navigation and docking small spacecraft will reduce the mass and complexity associated with traditional rendezvous and docking systems.

OAAN is a collaboration between NASA's Langley Research Center in Hampton, Virginia, and Cornell University in Ithaca, New York. This collaboration is designed to leverage Langley's successful spaceflight experience in order to perform systems engineering, develop a novel docking mechanism and test autonomous flight software for the OAAN project. Cornell's expertise with small satellites, high agility guidance, navigation and control, and CDGPS, will be used to deliver relative navigation, propulsion and attitude determination, and control systems.

OAAN is a Space Technology Mission

Directorate (STMD) Early Career Initiative (ECI) project. The ECI provides an opportunity to develop NASA early career technologists and to advance the next generation of innovators. The OAAN project is managed by the Small Spacecraft Technology Program (SSTP), which is chartered to develop and mature technologies to enhance and expand the capabilities of small spacecraft with a particular focus on communications, propulsion, pointing, power, and autonomous operations. SSTP is one of nine programs within NASA's STMD.

**For more information about the SSTP, visit:**
http://www.nasa.gov/smallsats/

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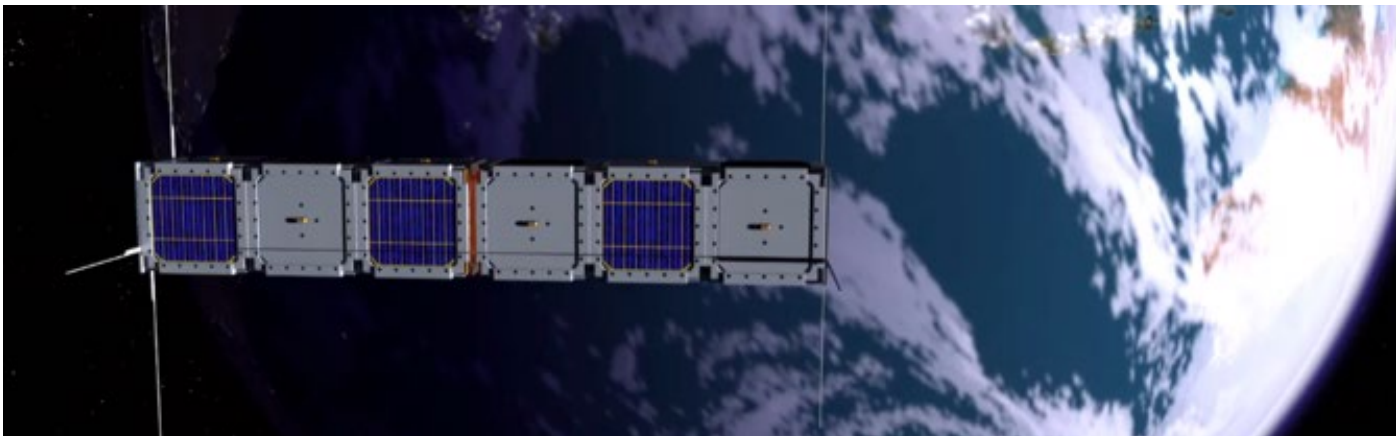

*Artist's concept of two OAAN satellites docking.*

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